SAND FILTER DETAILED KCRTS ROUTING METHOD WORKSHEET

2005 Surface Water Design Manual

Project: _____

METHODS OF ANALYSIS (Section 6.5.2.1) Detailed KCRTS Routing Method

Step 1) Determine whether a basic or large sand filter is needed.

Basic or Large Sand Filter?	_____	See Section 1.2.8 (map) and Section 6.1(menus)
%runoff volume to be treated	_____	90% for basic and 95% for large

Step 2) Determine rainfall region and regional scale factor.

Rainfall Region: Landsburg or Seatac?	_____	(unitless)	Required Figure 3.2.2.A
Regional Scale Factor:	_____	(unitless)	"

Step3) Create inflow time series

If the sand filter is upstream of detention, the time series is that of the developed site.

If the sand filter is downstream of detention, the time series is that leaving the detention pond.

In KCRTS at the main menu, select "CREATE a new time series" to generate the inflow time series

Select project location	_____		Seatac or Landsburg
Enter Till Forest	_____	(acres)	
Enter Till Pasture	_____	(acres)	
Enter Till Grass	_____	(acres)	
Enter Outwash Forest	_____	(acres)	
Enter Outwash Pasture	_____	(acres)	
Enter Outwash Grass	_____	(acres)	
Enter Wetlands	_____	(acres)	
Enter Impervious	_____	(acres)	
Enter scale factor	_____		0.8 to 1.1
Enter time step: 15-min	_____		
Enter data type: Reduced or historic	_____		
Select "Compute total area"			
Enter time series file name	*BG-IN1*		Name of inflow time series, default *.TSF

Select "Compute time series", Overwrite file, press "F10" to view information.
Press "Enter" to return to main menu

Step 4) Determine the design overflow volume

For off-line (high flows bypass the facility) sand filters the design overflow volume is zero and a flow splitter diverts flows above 60% of the 2-yr peak discharge 15 min time steps.

For the on-line (all flows go through the sand filter pond) sand filters, the ……..

On-line or off-line sand filter? _____

At the KCRTS main menu, select "Enter the analysis TOOLS module," then "Compute VOLUME discharge"

Enter time series file	*BG-IN1*		Inflow hydrograph previously named
Enter output time series file	*BG-IN1*		Name data file, default *.PRN
Enter start date	*10/1/0 0:00*		Required 10/1/0 0:00
Enter end date	*9/30/8 23:59*		Required 9/30/8 23:59
Select "Extract discharge volume"			
Note "Discharge Volume" (V_d) results	_____	(acft)	Inflow volume
% runoff volume to overflow ($\%V_{rf}$)	_____	(%)	10% for basic; 5% for large (Step 1)
Calc. design overflow volume = $\%V_{rf} * V_d$	_____	(acft)	Maximum overflow volume
Select "Save to BG-IN1.PRN", then select "Return to Previous Menu"			

Step 5) Define sand filter modeling parameters and Step 6) Size the sand filter

In KCRTS at the main menu, select “Size a Facility”

Enter R/D Facility (filename)	*BG-SF1*	Automatically *.RDF

Switch to “Manual” Design Technique

Select “Create a new R/D Facility," then select “Infiltration Pond”

Enter side slope		Horizontal component
Enter bottom area	(sqft)	
0r bottom length (ft)		
bottom width (ft)		
Enter effective storage depth before overflow	(ft)	
Enter Elevation at 0 stage	(ft)	
Enter Vertical permeability	(min/in)	
Toggle to desired bottom surface		Permeable Required
Toggle to desired side surface		Impermeable Required
Enter Riser Head	(ft)	
Enter Riser Diameter	(in)	12-36" See 6.5.2.2 and 5.3.1.1
Enter Number of orifices		
Select top of riser	*flat*	

Select "Point of Compliance"

Enter inflow time series name	*BG-IN1*	

Select “Return to Facility Edit”

Skip Test Hydrograph List and Define Riser Orifices and Notch

Select "Save to *.rdf"

Step 7) Route inflow time series through sand filter and compare volumes

Select “MODIFY auto Analysis setup”

Toggle to "Skip Peaks" from "Calculate Peaks"

Toggle to "Do not Notify" from "Notify"

Leave Duration Calcs? Prompt at default "Skip Durations"

Toggle to "Calculate Volume" from "Skip Volume"

Select “Edit peak/Duration/Volume Information”

Enter start date	*10/1/0 0:00*	Required 10/1/0 0:00
Enter end date	*9/30/8 23:59*	Required 9/30/8 23:59

Select “Return to facility Design Menu”

Select "OVERWRITE File"

Select “Route Time series & perform auto analysis”

Press “F10” to display routing data, then press return again for volume calculation

Press “F10” to view volume results when R/D Facility menu displays.

Press "Enter" to return to R/D facility menu.

KCRTS will display the time series flow volume. Compare the discharge volume with design overflow volume calculated in Step 4. If outflow volumes exceed design, the filtered volumes do not meet the treatment goal requirement and increase sand area and/or pond volume and route again. If outflow volumes significantly exceed design, decrease sand area and/or pond volume and route again. If outflow volumes do not exceed design, the treatment goal requirements are met.

Sand Filter Area (sqft)	*Discharge Volume (ac-ft)* *Target=*

To Adjust Sand Filter Geometry, Re-route Flows and Re-check Flow Volumes

Select “Edit facility” at R/D Facility menu

Edit data to change facility, then select “save to *.rdf”

Select "Overwrite File"

Select “Route time series and perform auto analysis”

Step 8) Size the underdrain system

* For feeder pipes, the design criteria in "underdrain systems"(6.5.2.2) can be used in lieu of analysis
* The collector pipe shall be sized to convey the 2-year 15-minute peak flow with 1' of head above the upstream invert. Capacity can be checked using the "KCBW" standard step back water program.

KCRTS dev., 2-yr peak flow (15-min steps) _____ (cfs)

Size Summary: Volume, Land area, and Cross Section

The land needed includes area for the pond, berms, access, and setbacks (6.2.3).

A_{top}=Pond top area. If Square, $(A_{sf}^{0.5}+2dZ)^2$ _____ (sf) "A_{sf}" from Step 5 and "d" from Step 3

Z= side slope length per unit height _____ (unitless) Select now

Total volume equals volume of ponded water (V_{wq}) plus volume to convey the 100-yr flow.

$V_{wq}=(A_{top}+A_{sf})d/2$ ponded water volume _____ (ft^3)

Cross-section includes underdrain system, sand depth (1.5 ft), pond depth ("d," max 6 ft), and freeboard